REMARKS

I. INTRODUCTION

In response to the Office Action dated February 23, 2005, which was made final, claims 2, 3, 17, and 18 have been amended. Claims 1-30 remain in the application. Entry of these amendments, and re-consideration of the application, are respectfully requested.

II. CLAIM OBJECTIONS

On page (2) of the Office Actions, claims 2, 3, 17, and 18 were objected to for informality reasons.

The Applicants thank the Examiner and have amended the claims to overcome the objections. The amendments were not made for reasons of patentability, and merely clarify the claim language.

II. PRIOR ART REJECTIONS

On page (2) of the Office Action, claims 1-6, 8-11, 14-21, 23-26, and 29-30 were rejected under 35 U.S.C. §102(b) as being anticipated by Hoyt et al, U.S. Patent No. 6,173,922 (Hoyt). On page (3) of the Office Action, claims 7, 12-13, 22, and 27-28 were rejected under 35 U.S.C. §103(a) as being unpatentable over Hoyt in view of Clarke, U.S. Patent No. 3,151,704 (Clarke). Applicants respectfully traverse these rejections in light of the amendments above and the arguments below.

The Hoyt Reference

The Hoyt reference discloses a failure resistant multiline tether. A tether having the special technical feature of multiple primary load-bearing lines and normally slack secondary lines is discussed. These primary and secondary lines are connected together with knotless, slipless interconnections so the tether maintains high strength and some of the lines can be cut without failure when it is operated near the ultimate failure load of the material from which it is constructed. The specific industrial applications of an electrodynamic tether system to deorbit satellites and a low Earth orbit to lunar surface tether transport system are also discussed. See Abstract.

As shown in FIG. 26, a box 2601 contains multiple spools 2602. As the Hoytether 2504 (sic shown as 2604) unwinds from the spool it deploys from the box. Empty spools 2606 (sic shown as 2603) act as spacers to maintain primary line separation in the deployed Hoytether 2504. See Col. 16, lines 9-13.

A charged particle moving in a magnetic field experiences a force that is perpendicular to its direction of motion and the direction of the field. When a long, conducting tether is flowing current (charged particles) they experience this force due to the fact that they are moving along the wire in the presence of Earth's magnetic field. This force is transferred to the tether and to whatever the tether is (like a spacecraft, satellite, space station or upper stage). See Col. 18, lines 14-20.

The Clarke Reference

The Clarke reference discloses a spring motor. The spring motor includes a second spring means for increasing the starting torque and/or the length of run. This spring means may take the form of a power spring of various types, such as a conventional power spiral spring, a torsion spring, or other suitable spring means. See Col. 2, lines 32-37.

The Claims are Patentable Over the Cited References

Independent claims 1, 16, and 19 are generally directed to an apparatus for trimming the mass properties of a spacecraft. An apparatus in accordance with the present invention comprises a storage spool mounted on the spacecraft, an output spool mounted on the spacecraft, and a flexible material having a first end coupled to the storage spool and a second end coupled to the output spool, wherein a length of the flexible material is distributed between windings of the storage spool and the output spool to adjust mass properties of the spacecraft.

Neither of the cited references teach nor suggest these various elements of Applicants' independent claims. Specifically, neither of the cited references teaches or suggests at least one of the following elements:

1. An output spool mounted on the spacecraft.
2. The second end of the flexible material coupled to the output spool.
3. A length of the flexible material distributed between windings of the storage spool and the output spool to adjust mass properties of the spacecraft.

These elements are addressed with respect to the cited references in order below.

1. The Cited References Do Not Teach Or Suggest An Output Spool Mounted On the Spacecraft

In Hoyt, several spools are discussed. These spools are used to create the tether, or in essence, hold the material used to create the various knotless and slipless connections needed to create the twisted forms of the material as shown in, for example, FIGS. 2a-2c, 3, 5a-5d, 6, 7, and 13a-13e of the Hoyt reference. The spools are shown as creating the tether in, for example, FIGS. 14, 15, 16, 18, and 19 of the Hoyt reference. However, none of these spools are an output spool for receiving the flexible material, or an output spool mounted on a spacecraft as recited in the claims of the present invention.

Although the Clarke reference teaches two spools, Clarke does not teach that the output spool is mounted on a spacecraft.

Combining the two references does not teach an output spool mounted on a spacecraft, since the tether (the flexible material) is extended from the spacecraft in the Hoyt reference, and even if combination of the two references is possible, any output spool taught by Clarke would not be mounted on the spacecraft.

2. The Cited References Do Not Teach Or Suggest The Second End of The Flexible Material Coupled to The Output Spool

In Hoyt, the second end of the tether is not attached to a spool. Typically, the second end of the tether is not attached to anything, see, e.g., FIGS. 6, and 26. The spool 2603 (which is described in the text as spool 2606) acts as a spacer to maintain separation of the lines that create the tether. The flexible material is not coupled to the spool 2603. There is no spool 2606 shown in FIG. 26, or elsewhere in the Hoyt reference, and, even if spool 2606 did exist, the text describing it as a spacer to maintain separation indicates that the second end of the flexible material cannot be attached to such a spool.

In some of the figures, one end of the tether is attached to some device, e.g., see FIG. 29 and the discussion in Cols. 16-17. However, this second device is not the

spacecraft; it is some other object, such as a burnt out upper stage, or a completely separate satellite.

Again, even if the two spools of Clarke were to be combined with the teachings of Hoyt, the tether of Hoyt would not be able to extend past the end of the spacecraft, and the teachings of the Hoyt reference would be discarded. The entire purpose of the Hoytether is to extend beyond the confines of a given object. As such, the two references, even if combined, cannot teach attaching a second end of the flexible material to the output spool.

3. The Cited References Do Not Teach Or Suggest A Length of the Flexible Material Distributed Between Windings of the Storage Spool and the Output Spool to Adjust Mass Properties of the Spacecraft

The Hoyt reference does not show that the tether is distributed between one place (the storage spool) and another (the output spool) to adjust the mass properties of anything, much less a spacecraft. The reference to spacecraft in the Hoyt reference uses the mass of one body (the first spacecraft) tied to the mass of another body (the burnt-out upper stage, or a second spacecraft) via the tether to keep one of the bodies in a given orbit. This does not adjust the mass properties of the first spacecraft.

Even if such an arrangement did adjust the mass properties of one of the two bodies, it does not adjust the mass properties by distributing the material; it adjusts the mass properties by tethering a large weight at the end of a string to the body whose mass properties are being adjusted. The length of the flexible material is not distributed between windings of one body and the windings of another body; it is lengthened or shortened to move one body closer or farther away from the other.

As argued in the previous response, Clarke does not discuss mass properties. The Clarke reference is directed toward a motor having a high starting torque in a specific direction. See Col. 1, lines 28-33.

If the Examiner is relying on inherency, such inherency "may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient." *Continental Can Co. v. Monsanto Co.*, 948 F.2d 1264, 1269(Fed. Cir. 1991). Instead, to establish inherency, the extrinsic evidence "must make clear that the

missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." *Continental Can Co.*, 948 F.2d at 1268.

In finding anticipation by inherency, the Office Action ignored the foregoing critical principles. The Office Action has not shown that the distributing of a length of the flexible material between windings of the storage spool and the output spool to adjust mass properties is necessarily present in the references of record.

As previously mentioned, the Clarke reference does not discuss mass properties. The Hoyt reference also does not mention mass properties. The only related discussion of mass in Hoyt, other than reducing the mass of the Hoyttether, revolves around separating a mass from the spacecraft via a long tether in Col. 11, line 40-Col. 12, line 14, as follows:

> Lowering a mass from a GEO spacecraft by a 1000 km long tether, will cause the center of mass of the system to drop, causing the GEO spacecraft to change to a non-geosynchronous orbital period. This will produce movement of the spacecraft and its tether with respect to the magnetic field of the Earth, allowing the electrodynamic drag interaction to take place, initiating the deorbit process. Another application where an ultra long tether may be optimal is the use of a electrodynamic tether around another planetoid where the magnetic field and/or space plasma is weaker than around the Earth.

Additional details of the discussion are found in Col. 26, lines 56-Col. 27, line 14, as follows:

> A stationary tether is one that connects two masses together and remains at constant length, except, of course, for deployment and retrieval. A stationary tether could drag a payload through the upper atmosphere of a planet and lower payloads to the surface of an asteroid. If the tether is conducting and is moving through electric or magnetic fields, then it can be used as a generator to provide electrical power, or as a motor to provide propulsion. If the tether and its masses are orbiting a massive body, then typically the system will be gravity gradient stabilized, with the tether pointed along the radius vector to the massive body. Thus, although the tether is stationary in the orbital reference frame, it is really rotating once per orbit in inertial space, and so is a slowly rotating bolo.
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> A bolo is a long rotating cable anywhere in space that is used as a "momentum-energy bank". It could be used to "catch" a payload coming from any given direction (in its plane of rotation) at any given speed (less than its maximum tip speed), and then some time later, "launch" the payload off in some other direction at some other speed. A gravity gradient stabilized bolo orbiting some planet has the property that if the tether is cut, then one-half

> an orbit later, the separation distance between the two masses is seven times larger than the initial separation. This can be used to deorbit the lower mass, or throw the upper mass to a rendezvous or to escape.

Hoyt does not teach or suggest changing the mass properties of a spacecraft by distributing the flexible material (the Hoytether) between a storage spool and an output spool (which would have to be supplied by Clarke); instead, Hoyt uses a length of the material to distribute two weights (the spacecraft weight and the burnt-out upper stage) by a large distance. The flexible material is not moved back and forth between the burnt-out stage and the spacecraft; the tether merely ties the two weights together. Further, the tether in Hoyt is specifically stated to maintain a constant length, and therefore except for deployment and retrieval, cannot be distributed between the two objects to adjust mass properties.

As such, when combined, the references actually teach away from Applicants' invention. For example, the combined references would teach that a large weight is deployed away from the spacecraft at a long distance, and the material is deployed in only one direction (Clarke's motor only works in one direction using the spring). This is not distributing a length of flexible material between windings of the storage spool and the output spool to adjust mass properties of the spacecraft as recited in the claims of the present invention. Further, even if it were adjusting the mass properties, the output spool would be on the second object, not on the spacecraft as recited in the claims.

The various elements of Applicants' claimed invention together provide operational advantages over the systems disclosed in Hoyt and Clarke. In addition, Applicants' invention solves problems not recognized by Hoyt and Clarke.

Thus, Applicants submit that independent claims 1, 16, and 19 are allowable over Hoyt and Clarke. Further, dependent claims 2-15, 17-18, and 20-30 are submitted to be allowable over Hoyt and Clarke in the same manner, because they are dependent on independent claims 1, 16, and 19, respectively, and because they contain all the limitations of the independent claims. In addition, dependent claims 2-15, 17-18, and 20-30 recite additional novel elements not shown by Hoyt and Clarke.

IV. CONCLUSION

In view of the above, it is submitted that this application is now in good order for allowance and such allowance is respectfully solicited. Should the Examiner believe minor matters still remain that can be resolved in a telephone interview, the Examiner is urged to call Applicants' undersigned attorney.

Respectfully submitted,

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